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Assistive Technologies and Advantageous Themes for Collaboration, Learning & Teaching within 3D Virtual Learning Environments

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Abstract. E-learning assisted through 3D Virtual Worlds such as Second Life, extending the more traditional 2D Virtual Learning Environments, presents advantageous motifs for collaboration, learning and teaching online. These main motifs include enriching communication and teaching means through 3D environments and game-like interaction, and enhancing the learning experience through avatar and virtual persona engagement. This paper aims to provide evidence from practice for the afore mentioned motifs and furthermore demonstrate that 3D Virtual Learning Environments offer beneficial themes to deliver education in three axes: as complement to physical education, supplement over 2D online virtual learning environments, and supplement over traditional real-life teaching methods. This evidence is provided through the Middlesex University DaCT village experience by i) identifying factors of successful and effective e-learning in 3D virtual worlds ii) setting the learning space for mode of learning iii) designing the space and iv) defining best teaching paradigms.

Background

3D online virtual environments have been flourishing in utilisation over the past decade for a multitude of purposes including socialisation, gaming, business and learning. Unlike other Multi-User Virtual Environments (MUVEs), the objective of 3D virtual worlds such as Second Life, Active Worlds, Blue Mars etc. [1] as Virtual Learning Environments (VLEs), is not the accumulation of points or completion

of quests or gaming, but the interaction between users, created by them rather than by the producers of a game [2]. It therefore becomes imperative to provide evidence for their advantageous contribution to education. This is achieved through features, explained subsequently, which make 3D VLEs attractive platforms for educational purposes enabling a number of different models for learning as follows:

Live synchronous learning between instructors and students via modifiable on-screen characters called 'avatars'. This type of use includes real-time normal classroom activities and interactions, meetings and consultations, role plays to develop communication skills, including lectures, discussions, case studies, collaborative projects, paper submissions, exams, and lab sessions where communication can be via text chat or audio [3].

Asynchronous interactions including the creation of objects 'in world' by one user for later inspection or use by another user. This might include students creating environments and objects of their own design for assessment [4].

Learning on demand through creation of 'machinima', which is video of the interactions between characters in the virtual environment, i.e. the creation of computer-generated imagery without the need for professional animation. Machinima can be used to depict realistic scenarios for later viewing by students or academics, and for purposes such as orientation, promotion and knowledge sharing. Its advantage is capability of being downloaded as an alternative to streaming especially in cases of low bandwidth or dial up connections. This helps create *narrative-centred learning environments,* in which students are actively involved in 'story-centric' problem-solving activities [5] e.g. as used by Faculty of Law - Queensland University of Technology to teach first year students basic negotiation skills of a fictional airline [6].

Characteristics for Achieving Successful and Effective E-learning in Virtual Worlds

As the uses of 3D virtual environments moved from entertainment to business development to education, it became more important to develop a scheme to analyze how these spaces function, and how we can best take advantage of what the spaces have to offer for education [7]. Through an analysis of many of the current virtual environments, a list of characteristics were found that have the most dominant effect on the kinds of communication that are possible in a 3D virtual space. These characteristics serve to evaluate and compare one environment with another, thus describing the communication mechanics in the space, how these mechanics influence education in the space, and finally how changes in these mechanics will influence the future of the space [3]:

Number of users: maximum number able to be logged on at the same time to attend an e-learning session without crashing the system

Dominant content form of the environment: i.e. whether text or image dominant environment

Persistence of Environment*: Persistent*: These environments exist when the user is not logged in. Changes in the environment remain from one use to the next. *Non-persistent*: These environments are instance-based, meaning that they only exist when called upon by the user

Stigmergy**:** allow users to leave messages, objects and other forms of communication for other users to find when they log in later.

User's relationship with other users: *Collaborative*: Users collaborate with the environment e.g. immersive spaces such as Second Life. *Antagonistic*: Users compete against the environment. In these spaces the environment's system provides enemies for the user to compete against. *Conditional*: Users are collaborative or antagonistic with the environment depending on the situation [3].

Furthermore, based on discussions by Calongne [4] depicting experiences of university staff in the delivery of courses using Second Life as an educational classroom, the following Figure 1 was generated illustrating a blend of derived characteristics required for successful virtual class experiences:

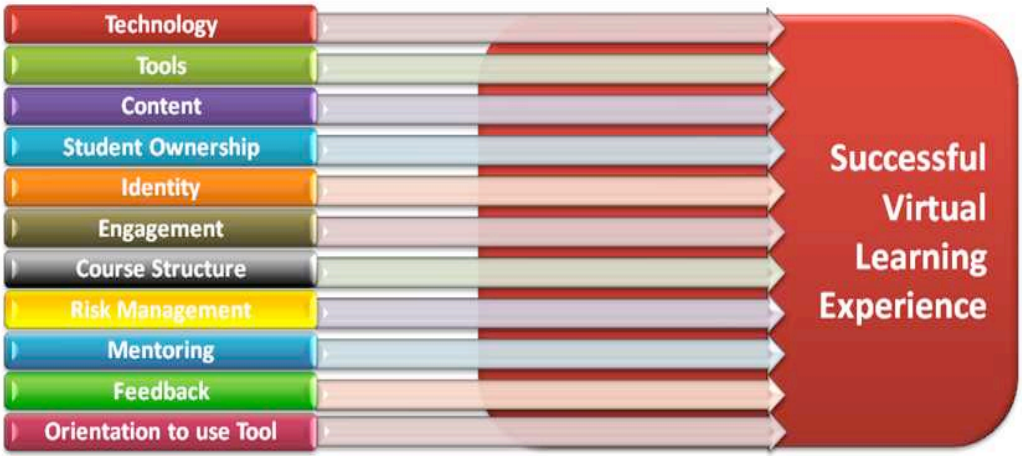

Fig1. Characteristics required for a successful Virtual Learning Experience

A combination of new online technological and teaching tools, suitable syllabus content and course structure, student personalised ownership of created and acquired objects and gadgets inside the virtual world, strong sense of identity and belonging "inworld", engagement and immersion in 3D virtual activities, mentoring or guiding students and providing them with prompt feedback "inworld", orienting students on how to use options and building tools etc. provided by the virtual world, and finally assessing risks taken by introducing all the above new learning concepts and techniques, all add to enhancing a student's e-learning experience inside 3D virtual worlds. Based on the above, the authors propose the following characteristics, explained in Figure 2 below, for achieving an effective virtual learning experience. These characteristics can be relayed to belonging to one of three categories of advantageous themes for using 3D virtual worlds as an educational tool, as follows:

- Proving that 3D VLEs enhance and complement traditional methods of learning in physical classrooms to result in higher educational achievement (points: 3- communication, 6- creation, 7- delivery, 8- assessment and feedback)
- Proving that 3D VLEs provide better opportunities and options for e-learning than those offered by available 2D Virtual Learning

environments (points: 1- self customisation, 2- inworld exploration, 4- 3D navigation, 5- 3D interaction)

- Proving that 3D VLEs not only support traditional methods of learning but also present e-learning opportunities that are not possible to attain using conventional real-life methods (points: 1- self customisation, 2- inworld exploration, 4- 3D navigation, 5- 3D interaction)

Fig2. Characteristics required for an effective Virtual Learning Experience

Setting the Learning Spaces for Modes of Learning

In accordance with achieving the preceding assertions for attaining effective e-learning, came the design concept of creating the DaCT (Distributed and Collaborative Technologies) village for the Middlesex University Island inside Second Life. The idea was to create several connected learning spaces that can cater for different modes or needs for collaborative learning.

Hence three buildings were initially created where all mentioned characteristics in the previous section, to achieve a successful and effective e-learning session, would be able to take place as follows:

i) An amphitheatre to host general lectures where focus would be mainly on delivering educational material by an instructor with minimal input expected or required by students. Since a lecture can include a large number of students (150 or more) [8], the amphitheatre was designed to hold 200 seats, taking into account future expansion of technology and server allowances within Second Life to hold such a number of simultaneously logged in users on one “sim” or island as opposed to the current maximum number of approximately 100 users [9].

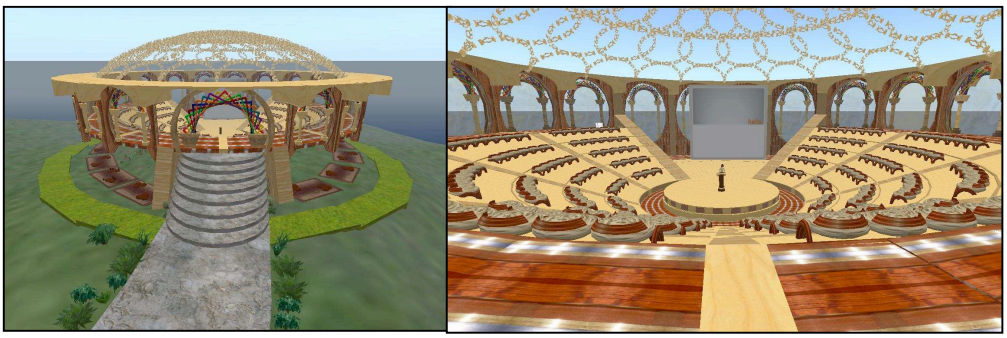

Fig3. Amphitheatre in DaCT village of Middlesex University Island

ii) A seminar hall was also built where discussions and debates can take place along with lecturing. This learning space was designed to hold 40 students, where a formal and informal setting of seats is provided.

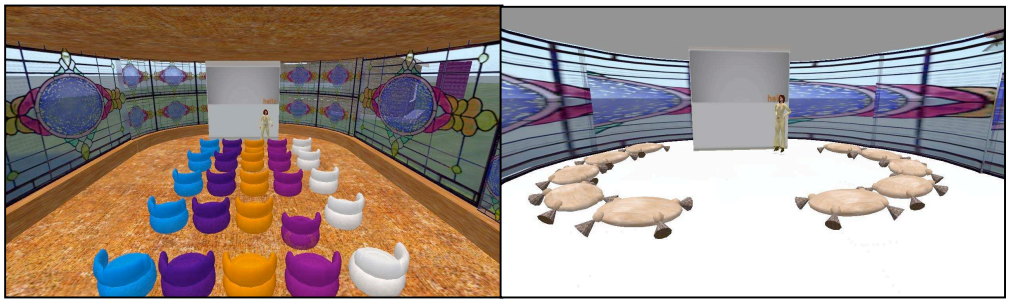

Fig4. Seminar hall in DaCT village of Middlesex University Island

iii) Lastly a smaller classroom was created where different collaborative hands-on activities can take place. In this space chairs and desks were provided to hold 20 students.

Fig5. Classroom in DaCT village of Middlesex University Island

Recommendations for Design features

To provide the most suitable environment for conducting e-learning sessions, the architectural design of the learning spaces, which students will use, should also be created according to best practices, not just prepare the spaces for the type or mode of learning to take place inside them as clarified in the previous section (e.g. lecture, seminar etc.). This is essential so as not to inhibit the potential of using these spaces efficiently and successfully according to the characteristics explained earlier.

However, 3D virtual learning spaces and educational buildings are currently being designed in an ad-hoc fashion based on designers' personal preferences or at best practices in accordance with real-life physical architectural conventions [10]. Whereas no academic research has been conducted to date depicting the effect of architectural, environmental or design features of buildings inside virtual worlds, such as Second Life, on the students' e-learning process [11], there have been general recommendations issued by researchers to enhance the design of educational spaces based on suggestions and propositions of students representing their satisfaction from their learning spaces. These propositions were taken into consideration during the creation of the buildings comprising the DaCT village described earlier.

Examples of such recommendations taken into account during the design process include using architectural and environmental elements such as landmarks, signs, to aid students' way finding [12], or using large scale spaces. Minocha & Reeves [13] further proposed using "open spaces as much as possible" to accommodate flying, wide corridors, realism in design, and arrangement of spaces to follow activities performed in them. A research on user orientation within 3D VLEs conducted by Charitos [14] showed that no rotation should be applied on a 3D build in relation to the path so as not to decrease the easiness with which a person orientates in this space. Additionally, based on other performed experiments, Bridges & Charitos [15] acknowledged that in general design of virtual environments, avatar movement in a virtual environment is significantly improved by the use of dynamic textures and rhythmically repeated elements in paths. Charitos also affirmed that ratio of dimensions of a space can induce avatar movement towards the centre or the boundary of that place (if square) or along its main axis (if horizontal or vertical) - hence a virtual space which has the volumetric proportions of a 'run' (i.e. one dimension is more than 2 or 3 times the other dimensions) induces movement towards the direction it indicates [16]. When applied to learning spaces this would be undesirable so as not to distract the students and instead keep their focus on the centre of educational space. This was therefore taken into consideration while designing the dimensional ratios of the three buildings. Previous research findings by the authors of the current paper at hand provide evidence that best student satisfaction is obtained when the percentage of open to closed surface area of walls and ceilings allowing lighting into the learning space is 50-60% open space [11]. Also there is strong preference towards light and bright finishing material for floors and walls, curved style windows, curved seating arrangements, high ceiling spacious areas, abundance of surrounding greenery and few circulation paths or corridors to reach destination [11].

As mentioned earlier, there are no design specifications or codes used in virtual worlds for erecting educational buildings or any buildings in general analogous to specifications used in the physical world. However, there are certain undocumented architectural design guidelines utilised by convention and practice in Second Life by designers and builders (including the authors), to counteract for

limitations in avatar movements, which were taken into consideration during creating the DaCT village buildings. For example, slopes of ramps or paths should not exceed a ratio of 1 (height):4 (width) (1:6 in the physical world), otherwise avatars would not be able to walk up on them or fall off. Height of steps which avatars can climb up can go up to 25cm as opposed to 17 cm in "real-life". Normal physical world 70x70cm seats appear too small in virtual worlds and thus should preferably be enlarged. Corridors and pathways must be much wider in virtual worlds than physical worlds for ease of manoeuvring and movement of avatars. Height of spaces should be larger than 3-4m (normal height in the physical world) to allow for flying and acceptable perspective since average avatar heights in virtual worlds is 7 feet as opposed to 6 feet in real life.

Teaching in Second Life - Philosophical approach to new paradigms in Teaching & Learning

After recognizing the preceding three essential requirements for delivering education i) identifying characteristics for achieving successful and effective e-learning sessions in virtual worlds e.g. Second Life, ii) preparing and setting educational spaces for the mode or purpose of learning, and iii) architecturally designing the spaces, comes the role of iv) selecting suitable educational techniques and approaches to conduct the e-learning sessions.

The philosophical approach adopted within this study for teaching within Second Life, as a representative of a 3D virtual world, is constructivism, where students are allowed to be active co-creators of their own education. Students are constantly asked to reflect on their activities and how these are helping them. They restate questions, assess discussed concepts and hence open room for research for future work. The instructor thus helps the students reconstruct the knowledge gained rather than reproduce certain facts. This is done using problem solving and decision making teaching techniques [17]. Constructivism as a chosen approach to teaching is perceived by the authors as concurrent in concept with the investigative and exploratory nature of the emerging 3D virtual worlds where new unorthodox prospects for learning can be expected. This approach would therefore

help reach ultimate benefit from the advantageous themes of learning in 3D virtual learning environments identified earlier in this paper, with the aid of the proper space setting and architectural design features recognised previously.

The learners observed within this study were different groups of undergraduate student classes, comprising in total of 60 students, within the School of Engineering and Information Sciences at Middlesex University. They were diverse in age (1st to 3rd year students), gender and social background. The material delivered to the students involved collaborative "inworld" activities, discussions via chat as well as real-life audio (mixed learning), and students were relocated between the 3 created venues to complete certain tasks.

Anecdotal Evidence and Findings

The constructivist approach adopted for teaching within this study had an impact on transforming students from passive to active learners, hence demonstrating the different characteristics of an effective e-learning session in 3D virtual environments formerly identified. For in addition to being willing participants regarding the presented educational material, students' "in-world" behaviour was also affected as noticed from the following findings coinciding with the characteristics of an effective e-learning session previously mentioned:

Self: A strong sense of identity could be seen through students' prevalent desire to change their avatar's appearance at the beginning of every session (and sometimes during sessions if circumstances allowed). Furthermore the apparent eccentricity of some who chose to represent themselves in unusual body shapes or sizes, or even dress up in bizarre or little clothing.

Exploration: There was a strong desire by students to explore the premises, including locating different positions for sitting every session even within the same venue; for example on the desk as opposed to the chair, above the board, window sill etc.

Communication: Students were extremely immersed in using text messaging to both the instructor and each other. It was apparent that they were able to express themselves more freely and ask or comment more than in their usual physical classroom condition

where they may be under scrutiny by others. Additionally these chat logs were saved for later inspection by students as review of the sessions.

Navigation: relocation from one space to the other during sessions with the instructor either by walking, flying or teleporting was very favourable among students when asked for as part of the session tasks.

Interaction: Collaborative group work was also very successful e.g. using a treasure hunt technique to find forensic evidence where every group member was responsible for retrieving different clues.

Creation: building objects or even buying and attaching "inworld" gadgets to one's avatar piqued the student's interest and helped visualize the explained material better; e.g. creating building blocks representing entity relationship diagrams.

Delivery / assessment and feedback: answering quiz questions or submitting comments or in-session project assignments was done using "in-world note-cards" either obtained from 3D objects available within the venue or by dropping directly onto the avatar or into the inventory of the student or instructor. Instant feedback from the instructor could also be obtained through in-world chat messaging, audio response or through note-cards dispatched to each student individually.

Conclusion

This study supplies evidence to the presence of the following effective characteristics for delivering education in 3D virtual worlds (used as learning environments): self identity, exploration, communication, navigation, interaction, creation, delivery and assessment. These are provided through three main advantageous themes: assistive to traditional physical education, offering options not available in 2D virtual learning environments, and offering options not available in the physical classroom. However to achieve best benefit from the above, attention must also be given to setting up an appropriate learning space suitable for the type or mode of learning and activities to take place inside it, choosing an appropriate teaching

approach, and also taking into consideration best practices for architectural design of the space involved.

References

[1] Ariane, B. (2010) *3D Virtual Worlds*. Retrieved 25 May, 2010, from http://arianeb.com/more3Dworlds.htm

[2] Butler, D. & White, J. (2008). A slice of Second Life: Academics, support staff and students navigating a changing landscape. In Hello! Where are you in the landscape of educational technology? *Proceedings ascilite Melbourne 2008*.

[3] Robbins, S. (2007). A futurist's view of Second Life education: A developing taxonomy of digital spaces In D. Livingstone & J. Kemp (Eds.). *Proceedings of the Second Life Education Workshop Community Convention*, pp. 27-33. Chicago Hilton: The University of Paisley

[4] Calongne, C.M. (2008). Educational Frontiers: Learning in a Virtual World, *EDUCAUSE Review,* vol. 43, no. 5

[5] Mott, B. W., Callaway, C. B., Zettlemoyer, L. S., Lee, S. Y, Lester, J. C. (1999). Towards Narrative-Centered Learning Environments. *Proceedings of the 1999 AAAI Fall Symposium on Narrative Intelligence* (pp. 78-82). Cape Cod, Massachussetts, November 1999.

[6] Agostinho, S. (2006). Using characters in online simulated environments to guide authentic tasks. In A. Herrington & J. Herrington (Eds.), *Authentic learning environments in higher education* (pp. 88-95).Hershey, PA: Information Science Publishing.

[7] Squire, K. (2002). Cultural framing of computer/video games. *Game Studies* Vol. 2 issue 1

[8] University of Sheffield (2008). *Lectures and Seminars*. Retrieved 20 May, 2010, from http://www.learningtolearn.group.shef.ac.uk/lect_sem/lectsem_seminars.html

[9] Smith, K. (2008). *Second Life Events: 10 Bad Habits To Break.* Retrieved 20 May, 2010, from World2Worlds, Immersive Virtual

Events: http://world2worlds.com/index.php/blog/34-blog-entries/65-second-life-events-10-bad-habits-to-break

[10] Minocha, S., Mount, N. (2009). Design of Learning Spaces in 3D Multi-user Virtual Environments. JISC Learning and Teaching Committee; The e-Learning Programme. http://www.jisc.ac.uk/whatwedo/programmes/elearningltig/delve.aspx (2009)

[11] Saleeb, N., Dafoulas, G. (2010). Architectural Propositions for Enhancement of Learning Spaces within 3D Virtual Learning Environments. *In Proceedings of the IEEE International Conference on Information Society (i-Society 2010)*, London, UK

[12] Dickey, M.D. (2004). An architectural perspective for the design of educational virtual environments. *Journal of Visual Literacy*, Vol. 24, no.1

[13] Minocha, S., Reeves A.J. (2009). Interaction design and usability of learning spaces in 3D multi-user virtual worlds. *Human Work Interaction Design*, Pune, India

[14] Charitos, D. (1999). Human Spatial Orientation in Virtual Worlds, in Ascott, R. (ed.), *Reframing Consciousness*, Bristol, UK: Intellect Books, ISBN 1-84150-013-5. pp. 223-228

[15] Bridges, A.H., Charitos, D. (2001). The Impact of form on Movement within Virtual Environments. *Automation in Construction*, Vol.10, No. 5, Elsevier Science BV, Amsterdam

[16] Charitos, D. (2005). Communicating Environmental Meaning through Designing Space in Virtual Environments. In Yla-Kotola, M.Y., Inkinen, S., Isomaki, H. (eds.), *The Integrated Media Machine: Aspects of Future Interfaces and Cross-Media Culture, Integrated Media Machine* Vol. III, pp.13-35. European Institute of Sustainable Information Society. Rovaniemi: University of Lapland, ISBN: 951-634-966-8, pp. 13-35.

[17] von Glasersfeld, E. (1995). A constructivist approach to teaching. In Steffe, L. and Gale, J., ed. Constructivism in Education, (pp. 3-16) NJ: Lawrence Erlbaum Associates.